Small Business Innovation Research/Small Business Tech Transfer

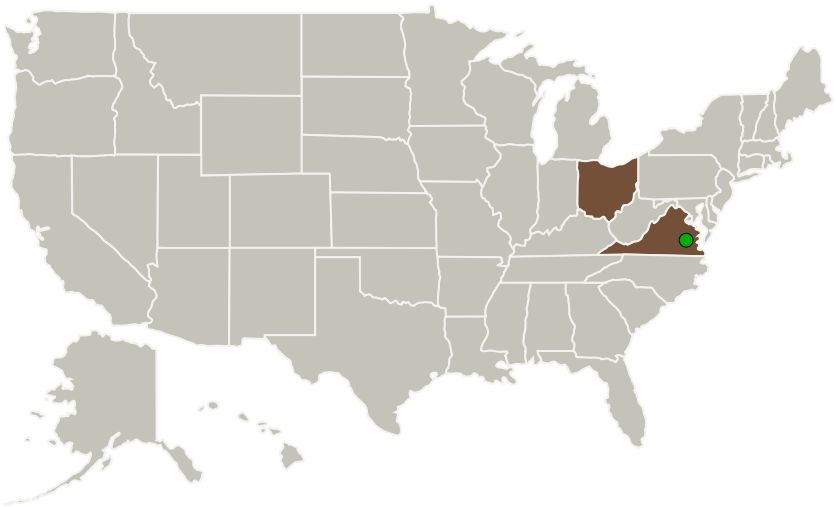
Flow Control on a High Lift Airfoil Using High-Bandwidth Microactuators, Phase I

Completed Technology Project (2016 - 2016)

Project Introduction

High-lift airfoils employ trailing edge flaps during takeoff and landing and are stowed during the cruise. These airfoils enhance the lift characteristics at subsonic speeds but suffer due to flow separation over the deflected flap surface. During cruise at transonic speeds, the shock induced separation results in drag penalty and structural fatigue. Traditionally, high-lift airfoils employ multi-element flaps to eliminate flow separation during takeoff and landing but at the cost of increased mechanical complexity and aircraft weight. Active flow control (AFC) has the potential to mitigate flow separation and enhance performance. The objective of proposed study is to design, develop, validate and implement a closed-loop, high-bandwidth active flow control technique. The technique will be based on high-momentum, resonance-enhanced unsteady microjet actuators and implemented on an NASA-EET high-lift airfoil configuration. Under the proposed program we bring a team of experts with the requisite knowledge and tools needed for successful development and implementation. We will deign and build a high-lift airfoil to suit the FSU polysonic wind tunnel for testing at high subsonic and transonic speeds (Mach 0.3 - 0.9). We will implement and demonstrate the applicability of Adaptive Sampling-Based Model Predictive Control (SBMPC) to control flow separation.

Primary U.S. Work Locations and Key Partners



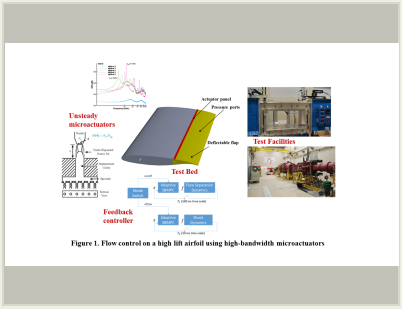


Figure 1. Flow control on a high lift airfoil using high-bandwidth microactuators

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Organizations Performing Work	Role	Type	Location
Spectral Energies, LLC	Lead Organization	Industry Small Disadvantaged Business (SDB)	Dayton, Ohio
Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations	
Ohio	Virginia

Project Transitions

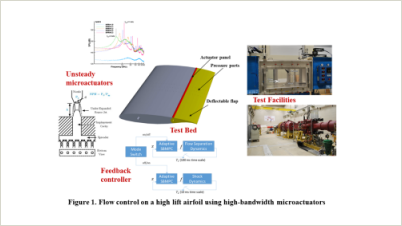
June 2016: Project Start

December 2016: Closed out

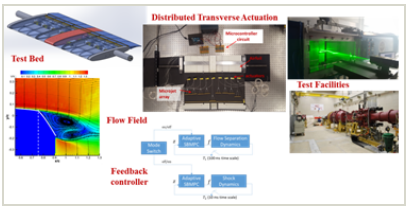
Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/139801)*

Images



Briefing Chart Image
Flow Control on a High Lift Airfoil Using High-Bandwidth Microactuators, Phase I
(https://techport.nasa.gov/image/126973)



Final Summary Chart Image
Flow Control on a High Lift Airfoil Using High-Bandwidth Microactuators, Phase I Project Image
(https://techport.nasa.gov/image/135696)

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
Spectral Energies, LLC

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

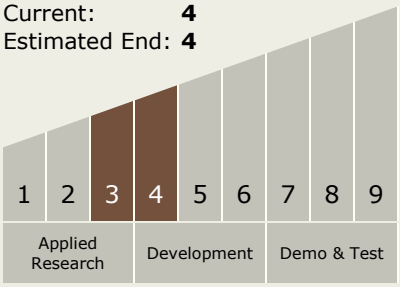
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Sivaram P Gogineni

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



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Completed Technology Project (2016 - 2016)

Technology Areas

Primary:

- TX15 Flight Vehicle Systems
  - TX15.1 Aerosciences
    - TX15.1.5 Propulsion Flowpath and Interactions

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System